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Publisher: Taylor & Francis

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Journal of Health Communication: International Perspectives

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/uhcm20>

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To cite this article: Suzanne E. Mitchell, Ekaterina Sadikova, Brian W. Jack & Michael K. Paasche-Orlow (2012): Health Literacy and 30-Day Postdischarge Hospital Utilization, *Journal of Health Communication: International Perspectives*, 17:sup3, 325-338

To link to this article: <http://dx.doi.org/10.1080/10810730.2012.715233>

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Health Literacy and 30-Day Postdischarge Hospital Utilization

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Low health literacy is associated with higher mortality, higher rates of hospitalization, and poor self-management skills for chronic disease. Early, unplanned hospital reutilization after discharge is a common and costly occurrence in U.S. hospitals. Still, few studies have examined the relation between health literacy and 30-day hospital reutilization rates. The authors examined the association between health literacy and 30-day reutilization of hospital services (readmission or return to the emergency department) in an urban safety net hospital, and conducted a secondary analysis of data from the control arm subjects of the Project RED and the RED-LIT trials. Health literacy was measured using the REALM tool. The primary outcome was rate of 30-day reutilization. The authors used multivariate Poisson regression analysis to control for potential confounding. Of the 703 subjects, 20% had low health literacy, 29% had marginal health literacy, and 51% had adequate health literacy. Sixty-two percent of subjects had a 12th-grade education or less. Subjects with low health literacy were more likely to be insured by Medicaid ($p < .001$); Black non-Hispanic ($p < .001$); unemployed, disabled, or retired ($p < .001$); low income ($p < .001$); and less educated (high school education or less, $p < .001$). The fully adjusted incidence rate ratio for low health literacy compared with adequate health literacy was 1.46 (CI [1.04, 2.05]). Low health literacy is a significant, independent, and modifiable risk factor for 30-day hospital reutilization after discharge. Interventions designed to reduce early, unplanned, hospital utilization after discharge should include activities to mitigate the effect of patients' low health literacy.

Nearly 20% of Medicare patients are readmitted to the hospital within 30 days of discharge (Jenks, Williams, & Coleman, 2009). Known predictors of early readmission include the following: lower socioeconomic status (Weissman, Stern, & Epstein, 1994), history of prior hospitalization (Van Walraven, Mamdani, Fang, & Austin, 2004) and advanced age (Cho, Lee, Arozullah, & Crittenden, 2008; Marcantonio et al., 1999),

This work was supported by the Agency for Health Research and Policy 1K08HS019771-01 (Dr. Mitchell). The authors acknowledge Ms. Jessica Martin for her support in data preparation.

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length of stay greater than 7 days (Krumholz et al., 1997), a high burden of comorbid illnesses (based on Charlson score; Librero, Peiro, & Ordinana, 1999), and specific diagnoses (e.g., depression, congestive heart failure, chronic obstructive pulmonary disease, myocardial infarction; Krumholz et al., 1997; Mitchell et al., 2010; Parashar et al., 2006; Wong et al., 2008). Meanwhile, a streamlined discharge process designed to enhance patient safety during care transitions can reduce 30-day postdischarge hospital utilization as much as 30% (Jack et al., 2009). The 30-day rehospitalization rate has emerged as an important indicator of hospital quality, particularly because the Centers for Medicare and Medicaid Services introduced a series of new reimbursement policies that include decreasing payments to hospitals with high rates of rehospitalization and bundled payment schemes in which accountable care organizations will be paid less for subsequent hospital utilization within 30 days. Thus, there is great interest in identifying modifiable risk factors for rehospitalization that could be used to refine intervention models and lead to improvements in quality of care, patient outcomes, and cost savings.

Low health literacy has been linked to poor health outcomes, particularly for patients with chronic conditions such as diabetes, asthma, cancer, depression (Lincoln et al., 2006), HIV/AIDS (Kalichman & Rompa, 2000), and heart failure (Peterson et al., 2011). *Health literacy*, defined as the degree to which individuals have the capacity to obtain, process, and understand health information, skills, and services needed to make informed health decisions and take informed actions, affects many Americans (Paasche-Orlow, 2011; U.S. Department of Health and Human Services, 2000). An estimated 26% of the U.S. population has low health literacy, and an additional 20% has marginal health literacy (Paasche-Orlow et al., 2005). Health literacy barriers are often associated with greater risk of hospitalization (Baker, Parker, Williams, & Clark, 1998), higher rates of self-reported poor health status (Baker, Parker, Williams, Clark, & Nurss, 1997) decreased knowledge of one's medical condition, poor medication recall, nonadherence to treatment plans, poor self-care behaviors (Evangelista et al., 2010), and increased all-cause mortality (Wolf, Feinglass, Thompson, & Baker, 2010). Patients with low health literacy also are more likely to report unsatisfactory patient–doctor communication at the time of discharge, suggesting that some physicians may be insensitive or unaware when their patients are having difficulties comprehending discharge instructions (Kripilani et al., 2010). Although several of these factors have been linked to an increased risk for 30-day rehospitalization, very limited evidence has been presented to demonstrate the independent association between low health literacy and hospital reutilization within 30 days of discharge.

This study examined the relation between health literacy and hospital reutilization within 30 days of discharge at the Boston Medical Center. The Boston Medical Center is the largest safety net hospital in New England, providing a spectrum of medical services to an urban, socially and economically diverse population. We hypothesized that low health literacy would be an independent risk factor for early unplanned hospital reutilization after discharge for general medical patients (i.e., adult patients admitted for acute general medical conditions such as pneumonia, unstable angina, pancreatitis, acute renal failure).

Method

We conducted a secondary analysis of the Project RED (Re-Engineered Discharge) and RED-Lit clinical trial data sets (clinicaltrials.gov identifier: NCT00252057) to assess the association between health literacy and the rate of subsequent 30-day hospital reutilization. The original Project RED included 738 participants and

RED-Lit included 802 participants. All Project RED studies enrolled English-speaking patients 18 years or older who were admitted to a general medical unit at the Boston Medical Center. Study subjects were required to have telephone access and be able to convey an understanding of study procedures and other consent elements in English. Participants were excluded if their admission was planned, they were on suicide watch, transferred from another health facility or were deaf or blind. Outcome data was not used in the secondary analysis if participants withdrew consent, died during the index admission, or were not discharged to the community. The combined sample included 1,540 patients from the control and intervention arms with complete information for the primary independent variable of interest—health literacy—and the outcome variable—30-day hospital utilization. We used a final sample of 703 patients identified from the control arms of each of these trials. Subjects from the intervention groups were excluded to eliminate effect modification introduced by exposure to the intervention.

Key Outcome Variables

The primary outcome variable for this analysis was a combined count measure of emergency department and hospital utilization events by a patient within a 30-day period after the index discharge. We also examined the emergency department revisit and hospital readmission count outcomes separately for the purposes of identifying factors associated with these distinct events. The number of utilizations ranged from 0 to 15; however, we top-coded to a count of 8 to avoid undue influence of outliers. We collected outcome data using the Boston Medical Center electronic medical record or participant self-report obtained by phone interview after 30 days. Both reutilizations of the Boston Medical Center and other hospitals and emergency departments were included.

Primary Independent Variable

We measured health Literacy using the Rapid Estimate of Adult Literacy in Medicine (REALM), which is a 66-item validated word recognition test (Davis et al., 1993). The REALM assigns a grade level of literacy, with scores of 0–18 corresponding to literacy of third grade or below, 19–44 to 4th–6th grade, 45–60 to 7th–8th grade, and 61–66 to 9th grade or above. For the purposes of our analysis, the two categories of lowest literacy were combined because of the distribution of scores. We administered the REALM in person to study participants.

Statistical Analysis

Descriptive Statistics

We performed bivariate analyses to assess the unadjusted relation between demographic and clinical characteristics and the three REALM categories of health literacy. The crosstabs reflect the results of chi-square tests. We then conducted Poisson regressions for all three outcome variables (combined reutilization, rehospitalization and return to the emergency department) to control for potential confounding. Predictors were included into the multivariable Poisson regressions on the basis of their effect on the association between health literacy and the outcomes, as well as the significance of their independent associations with the outcomes. Predictors were chosen from: age, gender,

marital status, income, insurance, employment, education, race, having a primary care physician, being homeless in the 6 months before the index admission, evidence of depressive symptoms, frequent utilizer status, length of stay, and medical comorbidity.

Adjusted Charlson Score for Comorbidity

Because of differences in the methods used to calculate Charlson scores between the RED and RED lit trials, we calculated a correction factor using a linear transformation procedure to adjust for the inconsistency in the distributions of Charlson scores for the combined analytic dataset. Charlson scores for the RED Lit II sample were calculated in a manner that accounted for comorbid conditions using all available records. For Project RED and RED Lit I, this process did not include outpatient record review. To derive a comparable Charlson score for the complete dataset, we calculated a z-score for each RED-lit II participant's observed score using the mean and standard deviation for the RED-lit II sample. Adjusted Charlson scores were then calculated for RED and RED-lit I (using the mean and standard deviation of this sample) to correspond to the z scores from the more comprehensively calculated sample.

Adjustment for Confounding

We constructed multivariable Poisson regression models using thorough backwards selection processes for each of the three outcome variables. We included certain variables (e.g., race, education, insurance) into the models because of their established relations with the variables of interest. We used SAS 9.1 to conduct the analysis with two-sided tests with $p < .05$ to judge significance.

Results

Of the 703 subjects, 138 (20%) patients had low health literacy (≤ 6 th grade or REALM score of 0–18), 207 (29%) had marginal health literacy (7th to 8th grade or REALM score of 19–44) and 358 (51%) had adequate health literacy (≥ 9 th grade or REALM score of 45–60). Study participants' mean age was 49.2 years of age, which did not differ by REALM score (see Table 1). Patients with low health literacy were more likely to be insured by Medicaid ($p < .001$); Black ($p < .01$), unemployed, disabled, or retired ($p < .001$); low income ($< \$40,000/\text{year}$, $p < .001$); and less educated (high school education or less, $p < .001$). Of subjects, 29% ($n = 206$) were frequent utilizers, defined as two or more admissions in 6 months before index admission. The mean length of stay for the index admission was 2.8 days and did not differ significantly by REALM score. The mean Charlson Comorbidity Index score was 0.6, with a majority of the sample reporting a score of 0. There was no relation between comorbidity and health literacy.

The unadjusted 30-day postdischarge hospital reutilization incidence rate ratio for subjects with low health literacy compared to subjects with adequate health literacy was 1.76 (95% CI [1.21, 2.55]). After adjusting for potential confounding using a multivariate Poisson regression analysis—which included education, gender, marital status, income, race, affiliation with primary care provider, homelessness, depression, frequent utilizer status, age, length of stay, and the Charlson Comorbidity Index—we found that patients with low health literacy are 1.46 times (95% CI [1.04, 2.05]) more likely than patients with adequate health literacy to return to the hospital or emergency department within 30 days. Frequent utilizers were 2.04 times more likely

Table 1. Sociodemographic characteristics by health literacy status

	Health literacy status, by REALM* score			Total	<i>p</i>
	1 ≤6th-grade level (<i>n</i> = 138)	2 7th–8th-grade level (<i>n</i> = 207)	3 ≥9th-grade level (<i>n</i> = 358)		
Gender					
Female	63 45.7	113 54.6	196 54.9	372	.15
Male	75 54.4	94 45.4	161 45.1	330	
Total	138	207	357	702	
Marital status					
Single, never been married	63 45.7	101 48.8	175 48.9	339	.07
Divorced, separated, or widowed	36 26.1	56 27.1	104 29.1	196	
Unknown	7 5.1	1 0.5	5 1.4	13	
Married	32 23.2	49 23.7	74 20.7	155	
Total	138	207	358	703	
Income					
No income–\$19,999	35 28.0	71 35.9	72 20.6	178	<.001
\$20,000–\$39,999	74 59.2	80 40.4	140 40.0	294	
\$40,000–\$74,999	12 9.6	30 15.2	70 20.0	112	

(Continued)

Table 1. Continued

	Health literacy status, by REALM* score			Total	p
	1 ≤6th-grade level (n = 138)	2 7th–8th-grade level (n = 207)	3 ≥9th-grade level (n = 358)		
Unknown or refused	0	7	22	29	
Total	0.0	3.5	6.3	673	
Insurance					
Free Care**	20	29	47	96	.02
Medicaid	14.5	14.0	13.1		
Medicare	70	97	133	300	
Medicare	50.7	46.9	37.2		
Other or unknown	24	21	35	80	
Private	17.4	10.1	9.8		
Total	8	10	30	48	
Employment	5.8	4.8	8.4		
Disabled or injured	16	50	113	179	
Part time	11.6	24.2	31.6		
Retired	138	207	358	703	
Student	46	53	74	173	.04
Total	35.1	25.7	21.0		
Other or unknown	12	23	38	73	
Private	9.2	11.2	10.8		
Total	24	23	54	101	
Employment	18.3	11.8	15.3		
Disabled or injured	2	4	9	15	
Part time	1.5	1.9	2.6		

Unemployed	29	56	61	146
Full time	22.1	27.2	17.3	181
Total	18	47	116	689
Education	13.7	22.8	33.0	
Incomplete high school	131	206	352	
Complete high school	60	62	44	166
Some college	43.5	30.0	12.3	<.01
Unknown	55	91	120	266
Complete college	39.9	44.0	33.5	148
Unemployed	9	33	106	
Full time	6.5	15.9	29.6	
Total	6	2	3	11
Education	4.4	1.0	0.8	
Incomplete high school	8	19	85	112
Complete high school	5.8	9.2	23.7	
Some college	138	207	358	703
Unknown				
Complete college				
Total				
Race				
Black	83	134	152	369
Hispanic	60.1	64.7	42.5	<.01
Other	21	23	34	78
Unemployed	15.2	11.1	9.5	
Full time	7	9	16	32
Total	5.1	4.4	4.5	
Education	9	10	9	28
Incomplete high school	6.5	4.8	2.5	
Complete high school	18	31	147	196
Some college	13.0	15.0	41.1	
Unknown	138	207	358	703

(Continued)

Table 1. Continued

	Health literacy status, by REALM* score			Total	<i>p</i>
	1 ≤6th-grade level (<i>n</i> = 138)	2 7th–8th-grade level (<i>n</i> = 207)	3 ≥9th-grade level (<i>n</i> = 358)		
Has primary care physician					
No	28	38	57	123	.48
Yes	20.3	18.4	15.9	580	
Total	110	169	301		
Been homeless in the past 6 months					
Yes	79.7	81.6	84.1	703	
No	138	207	358		
Total	22	24	40	86	.33
Depressive symptoms***					
Depressive	15.9	11.7	11.2	616	
Not depressive	116	182	318		
Total	84.1	88.4	88.8	702	
Depressive symptoms***	138	206	358		
Depressive	40	45	78	163	.19
Not depressive	29.0	21.7	21.8	540	
Total	98	162	280		
Depressive symptoms***	71.0	78.3	78.2	703	
Total	138	207	358		

Frequent utilizer status					
Two or more admissions in the 6 months before index admission	41	54	111	206	.46
Fewer than two admissions in the 6 months before the index admission	29.7	26.1	31.0		
	97	153	247	497	
	70.3	73.9	69.0		
Total	138	207	358	703	
Age, M (SD)	51.23 (13.91)	49.42 (13.51)	48.14 (14.77)	702	
Length of stay, M (SD)	2.69 (2.57)	2.86 (2.52)	2.72 (2.38)	702	
Charlson Comorbidity Index, M (SD)	0.719 (1.592)	0.595 (1.382)	0.499 (1.341)	703	.03

Note. Some columns may not add up to 100% because of omission of the “Other” categories. REALM: Rapid Estimate of Adult Literacy in Medicine. *REALM scores are typically categorized into four categories; however, because of the distribution of the scores, the lowest two categories were combined into one category, resulting in three REALM categories.

**Free Care was a program in Massachusetts that aimed to fund medical care for uninsured individuals.

***Positive depression symptom screen determined by the Patient Health Questionnaire-9 screen tool, a nine-item 4-point Likert scale, standard scoring algorithm to screen for major and minor depression. A score of 5 or higher indicates a positive depression symptom screen.

than nonutilizers (incidence rate ratio = 2.04 [1.58, 2.62] $p < .0001$) and those who were homeless in the 6 months before their index admission were 1.54 times more likely than those who were not homeless (incidence rate ratio = 1.54 [1.14, 2.08] $p = .0053$; see Table 2) to return to the hospital or emergency department. Female gender (incidence rate ratio = 0.75 [0.58, 0.96] $p = .02$) and Black race (incidence rate ratio = 0.73 [0.55, 0.98] $p = .04$) were both associated with lower risk for early hospital reutilization. In subanalyses of the outcome variable, we used multivariate Poisson regression to examine incidence rate ratios for emergency department visits and hospital readmissions separately. We found that, compared with patients with adequate health literacy, low health literacy patients were 1.71 times more likely to be readmitted to the emergency department ($p < .05$) and 1.67 (95% CI [0.98, 2.83], $p < .06$, times more likely to be readmitted into the hospital within 30 days of index admission.

Discussion

Concern about 30-day unplanned hospital reutilization is warranted as these events correlate with higher morbidity, mortality, and costs and is being used as a marker of the quality of hospital care (Ashton, Del Junco, Soucek, Wray, & Mansyur, 1997). Our study suggests that patients with low health literacy are more likely than patients with adequate health literacy to return to the hospital or emergency department within 30 days of discharge. These results were robust and health literacy remained an independent predictor of hospital utilization within 30 days of discharge after adjusting for a range of potential confounding phenomena, including education level. This study adds to growing evidence demonstrating the negative consequences of limited health literacy on patients' health and well-being (Davis & Wolf, 2004). It also establishes a link between health literacy and the process of care transitions, which has emerged as a centerpiece of efforts to improve quality and decrease cost.

There are several potential reasons as to why patients with low health literacy may return to the hospital soon after their discharge relative to those with higher health literacy levels. Health literacy may prevent patients from understanding their discharge instructions—including proper comprehension of their diagnosis and the treatment regimen (Anonymous, 2009; Williams et al., 1995). Williams and colleagues who showed that patients with low health literacy misread medication dosing (23.6% incorrect) and appointment slips (39.6% incorrect) in a survey of hospitalized patients while those with adequate literacy did well on these tasks. Patients may also have difficulty managing self-care instructions after hospital discharge, such as understanding symptoms of medication side effects and how to mitigate such phenomena, appreciating early signs of disease exacerbation and responding appropriately, and accessing and utilizing routine and urgent outpatient services. These issues may all contribute to how health literacy is related to returning to the hospital.

Our results bring attention to the need for interventions designed to decrease the rate of unplanned hospital reutilization to focus on health literacy. Such interventions can augment the level of patient and family education and guidance that is provided. Agency for Healthcare Research and Quality offers an evidence-based toolkit to address health literacy titled, "Health Literacy Universal Precautions Toolkit." The toolkit notably addresses four strategies for overcoming health literacy barriers. These include the following: (a) using easily understood spoken communication, (b) modifying written communication, (c) teaching self-management and empowerment, and (d) bolstering patient's support systems. Agency for Healthcare Research and

Table 2. Adjusted incident rate ratio of hospital utilization within 30 days of discharge

	Multivariate Poisson regression with reutilization			
	Estimate	Wald 95% confidence limits		<i>p</i>
Intercept	0.41	0.20	0.82	.01
REALM				
≤6th grade	1.46	1.04	2.05	.03
7th and 8th grade	1.36	1.00	1.85	.05
≥9th grade	1.00	1.00	1.00	
Education				
Incomplete high school	0.96	0.62	1.48	.85
High school or equivalent	1.18	0.80	1.72	.40
Incomplete college	0.87	0.55	1.36	.54
Unknown	0.65	0.14	3.13	.59
Complete college	1.00	1.00	1.00	
Gender				
Female	0.75	0.58	0.96	.02
Male	1.00	1.00	1.00	
Marital status				
Single, never married	0.86	0.63	1.19	.37
Divorced, separated, or widowed	1.05	0.74	1.49	.78
Unknown	0.76	0.21	2.72	.68
Married	1.00	1.00	1.00	
Insurance				
Free Care*	1.15	0.73	1.80	.55
Medicaid	1.24	0.89	1.74	.21
Medicare	1.04	0.64	1.68	.88
Other or unknown	0.96	0.49	1.91	.92
Private	1.00	1.00	1.00	
Race				
Black	0.73	0.55	0.98	.04
Hispanic	0.73	0.47	1.12	.14
Other	0.76	0.46	1.25	.28
White	1.00	1.00	1.00	
Has primary care physician				
No	0.96	0.69	1.34	.82
Yes	1.00	1.00	1.00	
Been homeless				
Yes	1.54	1.14	2.08	.005
No	1.00	1.00	1.00	
Depressive symptoms**				
Depressive	1.24	0.96	1.60	.09
Not depressive	1.00	1.00	1.00	
Frequent user				
Two or more admissions	2.04	1.58	2.62	<.0001

(Continued)

Table 2. Continued

	Multivariate Poisson regression with reutilization			<i>p</i>
	Estimate	Wald 95% confidence limits		
Fewer than two admissions	1.00	1.00	1.00	
Age, continuous, increment of 1 year	0.99	0.98	1.00	.14
Length of stay, continuous, increment of 1 day	0.99	0.94	1.04	.61
Charlson Comorbidity Index, continuous, increment of 1 unit	1.00	0.91	1.09	.92

Note. Some columns may not add up to 100% because of omission of the “Other” categories. REALM: Rapid Estimate of Adult Literacy in Medicine.

**Free Care was a program in Massachusetts that aimed to fund medical care for uninsured individuals.

**Positive depressive symptom screen determined by the Patient Health Questionnaire-9 screen tool, a nine-item 4-point Likert scale, standard scoring algorithm to screen for major and minor depression. A score of 5 or higher indicates a positive depression symptom screen.

Quality’s approach advocates for creating an environment in which patients of all health literacy levels can thrive. Some of these methods include the following: drawing pictures, using plain (nonmedical) language, and using the teachback approach (Brach et al., 2012; Koh et al., 2012; Weiss, 2003).

Limitations

Major strengths of the present study are the reasonably large dataset and the broad range of covariates available for analyses. However, several limitations should be noted. First, this study was conducted using data from clinical trials implemented at a single safety net hospital; therefore, results may not be generalizable to other patient populations. Further, reutilization events outside of the Boston Medical Center were collected by subject self-report but were not independently confirmed. However, we were able to confirm 91% of all events by medical record review. Last, although we attempted to account for known confounders, other factors may also exist and could remain unaddressed.

Conclusion

Our study suggests that low literacy is significantly associated with a higher rate of 30-day postdischarge hospital utilization. Patient health literacy plays an influential role in health outcomes and low health literacy can be a significant barrier to patients’ safe transitions from hospital to home. Future directions include interventions to improve patient education for care transitions, reduce the health literacy burden of the discharge process, and remove unnecessary complexity from critical self-care tasks.

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